Natural Attenuation and Bioremediation

Decontaminating surface soils and subsurface sediments is an ongoing process, but it is facilitated by a vast array of nature's widely distributed microorganisms. INL researchers are working to define how microbes live and interact in surface soils and saturated and unsaturated subsurface materials. The aim is to describe and control the intrinsic biogeochemical processes that destroy or immobilize contaminants. We focus on three areas:

1. Techniques for obtaining aseptic samples from the deep subsurface
2. Geochemical and microbiological approaches to resolve environmental contamination issues
3. Low-cost solutions to waste problems

Sampling processes include innovative techniques for recovering and handling of subsurface core from saturated and vadose zones in consolidated and unconsolidated media. Tracer strategies are employed to ensure sample quality. Specific projects include:

- Using microbial community-level bioassays and molecular tools to distinguish microbial populations within distinct chemical or geophysical regimes
- Determining the survival and transport of microorganisms in the context of geological constraints
- Assessing how fine-scale vertical heterogeneity determines the characteristics of microbial communities
- Testing samples from both pristine and contaminated subsurface environments to determine the environmental conditions that dictate distribution, types, and numbers of organisms that catalyze biogeochemical reactions.

Progress

We have found that microorganisms in the subsurface of the Snake River Plain live primarily in basalt fractures and sediments. In areas where chlorinated solvents have been disposed, cores from the subsurface yield viable communities of methanotrophs and phenol-oxidizers, which are microorganisms known to degrade chlorinated solvents. Groundwater contaminated with trichloroethene (TCE), a waste formerly placed in an injection well at INL's Test Area North site, has shown favorable bioremediation progress as indigenous microbes have responded to the introduction of nutrients. The TCE concentration levels and plume dimensions in the aquifer have shown encouraging reduction as bioremediation trials have proceeded. The methanotrophs in the aquifer subsist upon methane dissolved in the groundwater and may play a role in the natural attenuation of chlorinated solvents. When stimulated by the addition of urea and molasses, some aquifer microorganisms alter the water chemistry to encourage calcite precipitation. We are studying accelerated calcite precipitation as a method of removing hazardous wastes, such as ^{90}strontium, from groundwater.

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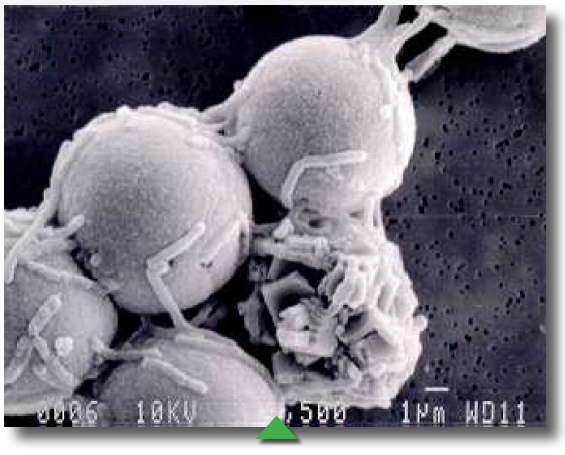

Electron micrograph of calcite precipitate.

The Energy of Innovation

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